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at the Convention would occupy a column or two of SCIENCE.

CYCLES OF PRECIPITATION IN THE UNITED STATES.

IN the *Monthly Weather Review* for October, Mr. L. H. Murdoch, Section Director of the Weather Bureau at Salt Lake City, considers the cycles of precipitation at that station and at other places. He finds for Salt Lake City a dry cycle between 1827 and 1864, during which the average annual rainfall was about 15 inches; a wet cycle from 1865 to 1886, with an average annual precipitation of 18.42 inches, and from 1887 to the present time a dry cycle, the average annual precipitation from 1887 to 1901 being 15 inches. From the records for San Francisco, Sacramento, Denver, Omaha, St. Louis, Cincinnati and Baltimore it appears that the country west of the Rocky Mountains had its wettest cycle from 1866 to 1887, while the middle Mississippi and Ohio valleys received their heaviest precipitation from 1840 to 1859. The present dry cycle is general from San Francisco to Baltimore. Mr. Murdoch finds no relation between his rainfall curves and Wolfer's sunspot tables, and concludes 'that there is no known natural law by which we can predict the length of the present dry cycle.'

The rainfalls for certain stations in the United States, it may be recalled, have lately been studied by Brückner, who finds that they correspond very well with his thirty-five-year climatic period. Mr. Murdoch makes no reference to Brückner's work along these lines.

R. DEC. WARD.

CURRENT NOTES ON PHYSIOGRAPHY.

ABANDONED CHANNELS OF THE MONONGAHELA.

THE Masontown-Uniontown folio of the Geologic Atlas of the United States by Campbell describes a part of the Alleghany plateau in southwestern Pennsylvania. The higher plateau, east of Chestnut-Laurel ridge, is referred with some doubt to a much wasted stage of the uplifted Cretaceous peneplain of the Appalachian province; the lower uplands, further west, represent an Eocene peneplain, now maturely dissected. The chief river is the Monongahela, whose curving valley had

been already well graded and opened by early glacial times; since then the river has cut a narrow trench 150 feet below its former valley floor. The trench is still so young that only slender discontinuous strips of flood plain are developed along it, on the inner side of curves; while the larger side streams enter the main valley with a strong slope, and still preserve the open flood plains of the earlier cycle in their middle course. But the most peculiar features of the district are the abandoned channels of the Monongahela at the level of the open valley floor. These are not normally cut-off, round-about channels, like those of the Meuse and Moselle, abandoned by wearing through the necks of the spurs that the river once contoured; for the new courses of the Monongahela are cut through broad, stout spurs for distances of a mile or more. Moreover, the abandoned channels are much clogged with silt, sand and gravel, with some boulders, to depths of 100 feet. Features of this kind are known in connection with several other north-flowing rivers not far south of the glaciated area, the most noted example being the heavily silted Teay valley, from which the Kanawha has turned northward to the Ohio. Campbell suggests that the new courses were taken when the old valleys were locally obstructed at various points by ice dams during the Kansan glacial epoch; each dam is supposed to have gained such strength that it endured for many years, and such height that it surmounted the level of some saddle among the hills on one or the other side of the main valley. Then silts and gravels were deposited in the ponded part of the river, while the new channel was incised in the saddle of overflow. The uplift by which the deepening of the new valleys below the older ones was brought about is dated as post-Kansan.

The hypothesis of local ice-dams, begun during the spring floods of frozen rivers and strengthened on account of the more severe climate of the early glacial epoch, seems at first reading hazardous from the number, height and duration of the dams required. The number of examples is, however, more in favor of the hypothesis than against it: if

the accident happened once, it might become a common occurrence. The height of the dams is in excess of examples ordinarily reported, but not vastly in excess. The duration needed for the dams is of difficult acceptance. On the other hand, the hypothesis is carefully studied out; it is literally a working hypothesis, in the sense that it will account for the observed facts. The alternative hypothesis of laked rivers, obstructed in their northward flow by the ice sheet itself, is of difficult application, in that it does not clearly lead to the desertion of old valleys, unless on the improbable supposition that the lakes were filled by silting and the silts were afterwards in great part removed.

LA CÔTE D'OR.

THE headwaters of the Seine and Yonne flow northwest through valleys well entrenched in the calcareous plateau of Langres, in the east-central part of France, whose surface at altitudes of 400 or 500 meters expresses the structure of the region. The Saône flows southward on the broad, aggraded plain of la Bresse at altitudes near 200 meters. Between the two is a dissected escarpment, determined by a fault with downthrow of several hundred meters on the southeast, whose sunny slopes or *côtes* have given name to the department, within the ancient province of Burgundy, of which Dijon is the chief city. Girardin describes the features of this interesting district: 'Le relief des environs de Dijon et les principales formes topographiques de la Bourgogne' (*Ann. de Géogr.*, XI., 1902, 43-53). The several elements of form are taken up in succession and explained in their relation to geological structure, as well as to human occupation. The isolated areas of upland, 'la montagne,' are dry, relatively barren, with few and poor inhabitants, whose number is decreasing. Residual mounds, 'hauteaux, montots, tasselots,' the remnants of once overlying strata, surmount the uplands. The slope, 'la côte,' strewn with stony waste from the rimming bluffs of the 'montagne,' is occupied with vineyards where well exposed to sunshine. Ravines or 'combes' and valleys, frequently

with large springs at the stream heads, are gnawing into the uplands from the low plain on the southeast, threatening the headwaters of the Seine system.

The subject of this essay invites fuller treatment in several directions. The development of topographic features in relation to time might be presented to advantage in greater detail: thus a better understanding could be gained of the effects of faulting on form, and of the relation of the montots to the combes. All of the elements of form could be better appreciated by the foreign reader if they were more explicitly related to the type examples of systematic physiography, so that each local instance should be presented as a variant upon a standard of its kind. Finally, several large problems invite attention in this district: What effect had the depression of the Saône basin on the headwaters of the Seine system? At what stage in the development of the valleys of the Seine system did the Saône depression take place? What changes have taken place since the depression occurred? Perhaps the French geologists are in a position to answer these physiographic questions, but the answers have not yet been given by French geographers.

CAÑONS OF THE EUPHRATES.

THE narrative of a trip 'Through the Great Cañon of the Euphrates River' on a skin raft, by E. Huntington (*Geogr. Journ.*, XX., 1902, 175-200), includes a graphic account of a number of physiographic features. The stretch of 190 miles along the river included something more than the great northwest bend within which Harput is situated. The journey occupied seven days, although only thirty-seven hours were spent in floating down the river. The region includes many subparallel ranges, trending northeast-southwest, and enclosing as many waste-floored basins. In the basins, the river is incised but little below the basin plain, its channel sometimes forming a braided network on an open flood plain with a fall of only two feet a mile. In the mountains the river follows narrow cañons, from 2,000 to 5,000 feet deep, with steep walls and no flood plain; here the channel is

often roughened with ungraded ledges or half barred with the fans of lateral torrents, and the fall rises to sixteen feet a mile. All these features point to a relatively recent deformation of the country, in consequence of which the river has aggraded the depressed basins and trenched the uplifted ranges. It is noted that only the smaller side streams cascade into the cañon; the larger ones have cut down their lateral ravines to grade with the main river. The analogy of the Euphrates and the Colorado in this respect is pointed out. The stationary condition of the native population is remarkable; the navigation of the river is still in the most primitive condition; an altar was seen 'covered with the gore of the scores of sheep and goats, which are brought as sacrifices by both Christians and Mohammedans'; irrigation is very poorly developed. The people could not understand the motive of the 'men with hats' in making so venturesome a journey down the river. A characteristic comment was: "They say they are not paid for making this journey, but we know better. * * * They know everything; they see a stone or a plant, a brook or a mountain, and they know it. * * * They write everything." A more general article by the same author, on 'The Valley of the Upper Euphrates River and its People,' has lately appeared in the *Bulletin of the American Geographical Society*.

W. M. DAVIS.

RECENT ZOOPALEONTOLOGY.

AGE OF THE TYPICAL JUDITH RIVER BEDS.

REFERRING to the recent communication of Mr. J. B. Hatcher and Professor S. W. Williston, on the subject of the age of the Judith River Beds, Mr. Hatcher remarks: 'I do not know upon what authority Professor Osborn makes this unqualified statement as to the deposits underlying the Judith River Beds.' I would say that the authorities for the Upper Cretaceous (and hence overlying) position of the Judith River Beds are partly cited in my recent memoir on 'The Vertebrata of the Mid-Cretaceous of the Northwest Territory,' namely, Cope ('Geology of the Judith River Basin,' 1876-7) and Cross ('Geology of the

Denver Basin'). In his Cretaceous Correlation papers (U. S. Geol. Surv., 1891) C. A. White clearly refers the Judith River Beds to the Upper Cretaceous (pp. 145, 147); furthermore, the references which he makes to the Mid-Cretaceous Belly River deposits do not include any allusion to the typical Judith River, and distinctly state (p. 166) that the equivalent of these Belly River is not recognized in Montana. I thought I had, therefore, abundant authority for the statement, 'among geologists of the United States there has never been any question as to the Laramie or Upper Cretaceous age of the typical Judith River Beds.' I had received from Mr. Hatcher, but unfortunately had quite overlooked, his paper in which the Mid-Cretaceous age of the Judith River was first suggested. Otherwise due acknowledgment would have been made. In the last edition of his 'Geology,' published in 1895, and after complete review of the literature, Dana refers to the Judith River Beds as Upper Cretaceous, equivalent to the Laramie. It would be difficult to find higher authorities than these, and it is impossible, in the preparation of a memoir, to trace back every single statement to its original source; we must accept some authority, otherwise every statement requires a prolonged piece of original investigation.

Mr. Hatcher has done decided service in calling attention to the fact that in the original description of the *typical locality* Meek and Hayden left the actual relation of the Judith River Beds undetermined. Naturally it is this typical locality to which we must turn. It is, therefore, in view also of Professor Williston's communication, of the utmost importance that the vertebrate horizons of the Cretaceous should be thoroughly restudied. All critical notices and observations on this important geological problem are most welcome.

The following communication of this nature has been received from Mr. Sternberg, under date of December 11:

"I have been reading in SCIENCE Mr. J. B. Hatcher's correction of your statement in regard to the Fort Pierre and Fox Hills Groups, underlying the 'true Judith River Beds,' and